

(19) World Intellectual Property Organization  
International Bureau(43) International Publication Date  
18 July 2002 (18.07.2002)

PCT

(10) International Publication Number  
WO 02/055581 A3(51) International Patent Classification<sup>7</sup>: C08G 67/04

(21) International Application Number: PCT/US01/50462

(22) International Filing Date:  
20 December 2001 (20.12.2001)

(25) Filing Language: English

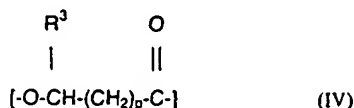
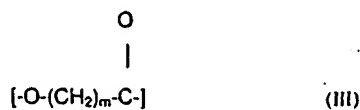
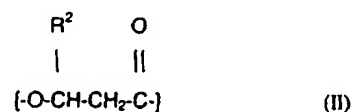
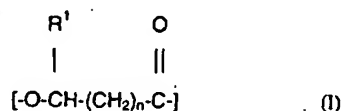
(26) Publication Language: English

(30) Priority Data:  
60/257,911 21 December 2000 (21.12.2000) US(71) Applicant (for all designated States except US): THE  
PROCTER & GAMBLE COMPANY [US/US]; One  
Procter & Gamble Plaza, Cincinnati, OH 45202 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): AUTRAN,  
Jean-Philippe, Marie [FR/US]; 217 Hillcrest Drive,  
Wyoming, OH 45215 (US). MELIK, David, Harry[US/US]; 4192 Intrepid Drive, Cincinnati, OH 45252  
(US). SATKOWSKI, Michael, Matthew [US/US]; 613  
Windingbrook Drive, Oxford, OH 45056 (US).(74) Common Representative: THE PROCTER & GAM-  
BLE COMPANY; c/o Mr. T. David Reed, 5299 Spring  
Grove Avenue, Cincinnati, OH 45217 (US).(81) Designated States (national): AE, AG, AL, AM, AT (uti-  
lity model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA,  
CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (uti-  
lity model), DE, DK (utility model), DK, DM, DZ, EC, EE  
(utility model), EE, ES, FI (utility model), FI, GB, GD, GE,  
GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ,  
LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN,  
MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG,  
SI, SK (utility model), SK, SL, TJ, TM, TR, TT, TZ, UA,  
UG, US, UZ, VN, YU, ZA, ZW.(84) Designated States (regional): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian

[Continued on next page]

(54) Title: BIODEGRADABLE POLYHYDROXYALKANOATE COPOLYMERS HAVING IMPROVED CRYSTALLIZATION  
PROPERTIES

(57) Abstract: Compositions having improved crystallization properties and physical properties comprise (a) a continuous phase of first biodegradable polyhydroxyalkanoate comprising a copolymer, or a blend thereof, of at least two randomly repeating monomer units (RRMU), wherein the first RRMU has the structure (I): (I) wherein R<sup>1</sup> is H, or C1 or C2 alkyl, and n is 1 or 2; and the second RRMU is different from the first RRMU and comprises at least one monomer selected from the group consisting of the structures (II) and (III): (II) wherein R<sup>2</sup> is a C3-C19 alkyl or C3-C19 alkenyl, and (III) wherein m is from 2 to about 16, and wherein the copolymer has a melting point T<sub>m1</sub>, and (b) a second crystallizable biodegradable polyhydroxyalkanoate homopolymer or copolymer, which comprises at least one randomly repeating monomer unit having the structure (IV): (IV) wherein R<sup>3</sup> is H, or C1 or C2 alkyl, and p is 1 or 2, and further wherein the second biodegradable polyhydroxyalkanoate has a melting point T<sub>m2</sub>, wherein T<sub>m2</sub> is at least about 20°C greater than T<sub>m1</sub>. The compositions are formed by solution or melt blending of the components (a) and (b) and may be formed into shaped articles.



patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(88) Date of publication of the international search report:

17 April 2003

**Published:**

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/50462

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 C08L67/04

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 C08L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document with indication where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 693 389 A (LIGGAT JOHN JAMIESON) 2 December 1997 (1997-12-02) cited in the application * the whole document *	1-10
Y	US 5 498 692 A (NODA ISAO) 12 March 1996 (1996-03-12) cited in the application * the whole document *	1-10
Y	ORGAN, BARHAM: "Phase separation in a blend of poly(hydroxybutyrate) with poly(hydroxybutyrate-co-valerate)" POLYMER, vol. 34, no. 3, 1993, pages 459-467, XP002207821 cited in the application * whole document *	1-10

---  
-/-

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

29 July 2002

Date of mailing of the international search report

16/08/2002

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Marsitzky, D

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/50462

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WTHEY, HAY: "The effect of seeding on the crystallisation of poly(hydroxybutyrate) and co-poly(hydroxybutyrate-co-valerate)" POLYMER, vol. 40, 1999, pages 5147-5152, XP002207822 cited in the application * whole document *	1-10
E	WO 02 28969 A (AUTRAN JEAN PHILIPPE MARIE ;PROCTER & GAMBLE (US)) 11 April 2002 (2002-04-11) * whole document *	1-10

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/50462

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5693389	A	02-12-1997	AU 683466 B2	13-11-1997
			AU 6727594 A	20-12-1994
			CA 2162173 A1	08-12-1994
			EP 0700418 A1	13-03-1996
			FI 955645 A	23-11-1995
			WO 9428070 A1	08-12-1994
			JP 8510498 T	05-11-1996
			NO 954748 A	23-11-1995
US 5498692	A	12-03-1996	US 5685756 A	11-11-1997
			US 5747584 A	05-05-1998
			AU 1056895 A	15-08-1995
			AU 730347 B2	08-03-2001
			AU 9820098 A	04-03-1999
			BR 9408512 A	04-03-1997
			CA 2181791 A1	03-08-1995
			CN 1142839 A	12-02-1997
			CZ 9602192 A3	11-12-1996
			EP 0739368 A1	30-10-1996
			FI 962997 A	26-07-1996
			HU 75180 A2	28-04-1997
			JP 9508423 T	26-08-1997
			NO 963104 A	27-09-1996
			NZ 276325 A	28-07-1998
			PL 315691 A1	25-11-1996
			RU 2137784 C1	20-09-1999
			SG 49114 A1	18-05-1998
			SK 97096 A3	09-04-1997
			TW 383316 B	01-03-2000
			WO 9520614 A1	03-08-1995
			US RE36548 E	01-02-2000
			US 5489470 A	06-02-1996
			US 5602227 A	11-02-1997
			US 5618855 A	08-04-1997
			US 5780368 A	14-07-1998
			ZA 9500627 A	05-10-1995
WO 0228969	A	11-04-2002	WO 0228969 A2	11-04-2002